An Innovative Septic Phaseout Program

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Approximately 65,000 septic systems and 35,000 private water wells remain in the JEA service areas of Duval, St. Johns, and Nassau counties. Over time, the City of Jacksonville (city), with technical support from JEA, has led multiple septic tank phaseout programs in areas without central water and sewer infrastructure. These infrastructure projects were accomplished through city capital project initiatives, with contributions by JEA. The work continues today with the current septic tank phaseout (STPO) program.

In 2003, the Water and Sewer Infrastructure Task Force was formed by the city and JEA. The task force recommended the development of a prioritization system for the phaseout of remaining septic systems. The prioritization system was created by the city's regulatory and environmental services department in consultation with the Duval County Health Department.

The 2003 prioritization system focused on environmental, public health, and welfare considerations, including the number of septic tank system repair permits issued, average lot size, soil potential, seasonal high water table, sanitary conditions, proximity to any surface water body, and potential for flooding in the areas. In 2016, the city and JEA collaborated to modify the STPO program approach to prioritization and allocation of funding to include certain additional community considerations.

To that end, a STPO project area matrix was jointly developed, which has been updated annually. The matrix included data in two distinct sections. The first section contained environmental, health, and welfare parameters with a maximum of 70 points possible toward an overall total score for prioritization. The second section contained community consideration parameters with a maximum of 30 points possible toward the overall total score.

The most recent 2020 matrix update resulted in the prioritization of approximately 22,000 residential parcels with existing septic systems (out of the total 65,000) into 35 STPO priority project areas. The top tier in the matrix (meaning the most important to implement) included three areas with septic conversion projects already underway at various stages: Biltmore C and Beverly Hills (under construction), and Cristobel (initiation of preliminary design engineering services). Historically the STPO program projects have replaced existing septic systems with conventional gravity collection systems.

An innovative wastewater treatment program (IWTP) was created to assess and recommend the most appropriate technologies and approaches (including centralized sewer, decentralized sewer and treatment, and/or improved onsite treatment) that could be applied to the remaining 32 prioritized STPO project areas. The planning documents developed as part of this project identified approaches that may also be used in the future for the approximately 43,000 additional septic systems that remain in Duval County.

Identification of Applicable Alternatives for the Septic Phaseout Program

A brainstorming exercise for outside-the-box ideas and a comprehensive literature and industry best practices review of regional, national, and international research related to innovative technologies, strategies, and frameworks for septic system replacement identified alternatives that were screened for applicability to the septic phaseout program. Peer-reviewed journal articles, conference proceedings, case studies, reports, and technical information from manufacturers in the United States and internationally were synthesized to identify limitations, challenges, and lessons learned.

Table 1. General Overall Characterization of 32 Septic Tank Phaseout Priority Project Areas

Description	Units	Minimum	Maximum	Average	Total
Total Parcels	no.	35	4,802	913	29,214
Septic Parcels	no.	34	3,714	735	23,516
Proportion Septic Parcels	%	49	100	83	
Proportion Residential Parcels	%	80	100	95	
Eq. Res. Units	no.	32	4,239	706	22,582
Average Res. Parcel Acreage	acres	0.19	1.82	0.45	
Vacant Acreage	acres	0	158	29	916
Vacant Government Owned Acreage	acres	0	28	4	138

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The literature review identified wastewater treatment technologies for both decentralized and onsite management strategies. Centralized collection system alternatives were assumed to utilize JEA's existing municipal wastewater treatment facilities.

The assessment included:

- *Technologies* - Equipment developed for wastewater collection, treatment, and/or effluent disposal (such as vacuum sewer system, biological treatment, and engineered wetlands).
- *Wastewater Management Strategies* - Strategies for managing STPO priority-area wastewater in lieu of existing septic systems (such as advanced onsite, decentralized, centralized, integrated, and source separation).
- *Institutional Frameworks* - Methods used to own, operate, finance, and implement wastewater management strategies (such as public, private, and design/build/operate/finance).

The identified onsite, decentralized, and centralized alternatives were preliminarily ranked based on the following:

- Ability to meet programmatic goals
- Technology maturity and experience
- Regulatory considerations/uncertainty
- Ease of management
- Sensitivity to flooding
- Reliability of equipment
- Odor
- Aesthetics
- Construction impacts
- Impact to property restrictions
- Net present cost

An overarching goal of the study was to identify best-value methods for accomplishing the large-scale septic-to-sewer conversion program.

Characterization of Project Areas

The 32 STPO priority project areas were grouped according to existing JEA wastewater treatment facility (WWTF) service areas. The STPO priority areas were located within six WWTF service areas:

- Arlington East
- Buckman
- Cedar Bay (District 2)
- Mandarin
- Monterey
- Southwest

Currently, no STPO priority project areas are within the Blacks Ford, Julington Creek Plantation, Ponte Vedra, Ponce de Leon, or Nassau Regional WWTF service areas. The STPO priority area characterization, which was used when assessing alternative wastewater capital improvements, included an analysis of existing customers, septic system density, land use, existing utilities, topography, other existing infrastructure and environmental factors (including sea level rise). Table 1 summarizes certain metrics for the aggregated 32 remaining STPO priority areas considered.

The 32 STPO priority areas were categorized based on similar septic system density (i.e., lot size) characteristics, and nine representative STPO priority areas were chosen for more-detailed planning-level cost analysis for various strategies and technologies.

Development of Recommended Septic Tank Phaseout Priority Area Wastewater Improvements

Recommended wastewater improvements for each STPO priority area were formulated by combining the characterization of each STPO priority area with the top-ranked identified wastewater management strategies, institutional frameworks, and technologies. This analysis resulted in recommended wastewater capital improvements for each STPO. The representative area planning-level cost estimates were used to estimate costs for the remaining priority areas. These costs, along with an additional eight criteria, were used to further evaluate wastewater capital improvement alternatives for each STPO priority area. The detailed evaluation resulted in a top-ranked wastewater capital improvement recommendation for each STPO priority area.

The STPO priority area characterization indicated that parcels with a topographic elevation below 6 ft could be significantly impacted by future sea level rise, with expected groundwater rise limiting the unsaturated thickness of the soil, which would hinder operation and treatment efficacy of some advanced onsite wastewater treatment systems and other technologies; therefore, only the STPO priority areas above this topographic limitation and with an average parcel acreage greater than 0.25 acres included onsite wastewater improvements as a solution alternative in the detailed evaluation.

For STPO priority areas, either located far away from existing JEA infrastructure or within an area of the JEA service area with limited available capacity, a low-cost approach to wastewater treatment could be a new decentralized wastewater treatment facility. A preliminary cost analysis for new infrastructure to the existing wastewater infrastructure point of connection (POC) indicated that only the areas with a POC greater than 4,000 lin ft from the boundary have the potential to offset the additional cost of decentralized treatment.

A total of approximately 23,516 prioritized unsewered parcels in the service area were evaluated for potential wastewater capital improvements. Of the total parcels, 22,913 (97 percent) were recommended to be served by a vacuum collection system, 207 connections were recommended to be served by a gravity collection system, and 223 connections were recommended to be served by a low-pressure collection system. The remaining 173 connections were recommended to be served by an advanced onsite treatment system. Planning-level cost estimates were prepared for each STPO priority project area for the purpose of defining the total wastewater capital improvement costs for the STPO program. A summary of the estimated capital costs for the STPO priority project areas is shown in Table 2.

The study identified that vacuum sewer collection systems were the best-value method for project areas with more than 150 existing septic systems. For remote project areas with large lots, the advanced onsite wastewater treatment systems met the project goals, and smaller project areas resulted in a mixture of low-pressure sewer collection systems and conventional gravity sewer as the best-value capital wastewater improvement.

Table 2. Septic Tank Phaseout Priority Areas Program Cost1 Summary (2020 dollars)

Description	Phaseout Cost 32 STPO Priority Areas	Phaseout Cost Per Connection (Average)
Estimated Total Capital Construction Costs	$783M	$39,000
Estimated 20-year Operation and Maintenance (O&M) Net Present Costs (NPC)[2]	$75M	$4,000
Estimated Total NPC	$858M	$43,000

[1] Preliminary engineer's opinion of probable construction costs (EOPCC) have been prepared based on master plan-level information. Because of the level of scope development at this stage, the estimate is an "order of magnitude" estimate as defined by the Association for the Advancement of Cost Engineering International (AACE) Class 5. The expected range of accuracy for this type of estimate is 50 to 100 percent. These costs have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material cost, competitive market conditions, final project scope, implementation schedule, and other variable conditions. As a result, the final project costs will vary from the estimate presented herein. The capital construction costs do not include new water services or new stormwater drainage aspects to the project areas.

[2] The presented 20-year O&M net present costs (NPC) were determined based on 2.5 percent discount rate, which is the current rate for federal water projects.

Conclusion

The conclusions and recommendations from the comprehensive one-and-a-half-year study effort included evaluations of multiple technologies, wastewater management strategies, and institutional frameworks. An overarching goal of the study was to identify best-value methods for accomplishing the large-scale septic-to-sewer conversion program. The septic tank conversions contemplated were evaluated (using weighted criteria) without consideration of other major construction within the public right of way.

It's possible that certain conversion project areas may ultimately include investments in water service, stormwater drainage, or other infrastructure which, if considered, could affect the weighted criteria analysis conclusions. For example, if a project area were to include major water and drainage improvements, the entire right of way may require roadway reconstruction. In such an instance, it's possible that a different sewer approach (e.g., gravity instead of vacuum) may ultimately represent a better value to JEA. Moreover, the technology evaluation presented here could be affected by changes to legislation, available funding, etc. Hence, review of all such factors will be considered during detailed design to validate the approaches identified and to develop final construction plans and estimated costs.